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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/388,031      | 09/01/1999  | SALMAN AKRAM         | 3442US(96-42        | 3303             |

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TRASK BRITT & ROSSA  
PO BOX 2550  
SALT LAKE CITY, UT 84110

EXAMINER

LEE, EUGENE

|          |              |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2815

DATE MAILED: 03/01/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/388,031

Applicant(s)

AKRAM, SALMAN

Examiner

Eugene Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 01 September 1999.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-28 and 100-129 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-28 and 100-129 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 September 1999 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: element 62a (see page 14, lines 20). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1 thru 15, and 102 thru 115 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification does not disclose an upper surface out of contact with any metal.

### *Claim Rejections - 35 USC § 102*

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

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(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

5. Claims 1, 4 thru 8, 10 thru 13, and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by Brennan et al. '943. Brennan discloses (see, for example, FIG. 2F) a semiconductor device comprising a substrate 200, TiN barrier layer (metal layer) 205, interconnect (single conducting layer) 210, and sidewall material (metal spacers) 240. Regarding the composition of the sidewall material, see, for example, column 4, lines 46-59. Even though the figures show an anti-reflective coating 215 contacting the interconnect 210, this coating is not required based on column 2, lines 40-42 (i.e. can be deposited) and claims 1 and 10 of Brennan.

- a. Regarding claim 5, see, for example, column 5, lines 25-30.
- b. Regarding claim 8, see, for example, column 5, lines 22-24.
- c. Regarding claim 12, see, for example, element 220 of FIG. 2F and column 5, lines 10-18.

6. Claims 1, 10 thru 13 and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by Liu et al. '745 B1. Liu discloses (see, for example, FIG. 1D) a copper electrical interconnect comprising a semiconductor substrate 2, copper layer (metal layer) 6, top barrier layer (single conducting layer) 8 and spacers 14. The spacers are formed from a passivating layer 12 made of Ta, TaN, TiN, etc. See, for example, column 4, lines 21-37. Regarding claims 12 and 13, see element 16 of FIG. 2D and column 5, lines 1-4.

7. Claims 16, 19, 20, 101, 116, 119, 120, and 129 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee '340 B1. Lee discloses (see, for example, FIG. 3F) a semiconductor

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device comprising oxide substrate 20, interconnection (metal layer) 28, third insulation layer (dielectric layer) 32, sidewall spacer (metal spacer) 36a, and second interconnection layer (conductive layer) 40. In column 4, lines 44-59, Lee discloses the sidewall spacer as being etched from a second barrier metal layer 36.

Regarding claim 19, see, for example, column 4, lines 43-44.

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 2, 3, 9, 100, 102 thru 113 and 115 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. '943 as applied to claims 1, 4 thru 8, 10 thru 13, and 15 above, and further in view of Cox '439. Liu does not disclose a dielectric layer on the substrate upper surface and underlying the metal layer. However, Cox discloses (see, for example, Fig. 2) a semiconductor device comprising conductive lines 54, 56, and 58 over an insulating layer 50a and substrate 50b. The insulating layer serves as a base upon which the conductive pattern is constructed. See column 5, lines 1-7. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include the insulating layer on the substrate of Liu in order to provide a further base for the semiconductor device.

Regarding claims 3 and 103, Liu in view of Cox does not disclose the dielectric layer being silicon oxide or BPSG. However, it would have been obvious to one of ordinary skill in

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the art at the time of invention was made to use silicon oxide or BPSG, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claims 9 and 109, Liu in view of Cox does not disclose the single conductive layer being an aluminum-copper alloy. However, it would have been obvious to one of ordinary skill in the art at the time of invention was made to use an aluminum-copper alloy, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

10. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. '943 as applied to claims 1, 4 thru 8, 10 thru 13, and 15 above, and further in view of Matsuno '502. Brennan does not disclose a fluorine-doped silicon oxide. However, Matsuno teaches that dielectric films doped with fluorine provide films with low dielectric constants. See, for example, see column 1, lines 20-63. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to add fluorine, in order to form a low dielectric film, and improve the overall speed of a semiconductor device.

11. Claims 17, 18, 23 thru 28, 117, 118, and 123 thru 128 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee '340 B1 as applied to claims 16, 19, 20, 101, 116, 119, 120, and 129 above, and further in view of Drynan '682 B1. Lee does not disclose the metal layer comprising tantalum, tungsten, cobalt, molybdenum or an alloy or a compound of any thereof, including TaN and TiN. It was extremely well known in the art at the time of invention to use

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these metals because of their high conductive properties and their suitability as interconnect structures. See, for example, column 17, lines 44-\* of Drynan. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to use one of these metals, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claims 26-28, Lee discloses the claimed invention except for one upper metal layer on the conductive layer and comprising Ti, Ta, W, Co, or Mo or an alloy or a compound of any thereof, including TaN or TiN. However, Drynan shows (see, for example, FIG. 26B) a semiconductor device comprising a third wiring layer (upper metal layer) 338a on top of a first contact plug 337a. The third wiring layer allows for more interconnections in the semiconductor device. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include an upper metal layer in order to have more wiring interconnections within the device.

12. Claims 21, 22, 121, and 122 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee '340 B1 as applied to claims 16, 19, 20, 101, 116, 119, 120, and 129 above, and further in view of Cox '439. Lee does not disclose the substrate comprising a dielectric layer underlying the metal layer. However, Cox discloses (see, for example, Fig. 2) a semiconductor device comprising conductive lines 54, 56, and 58 over an insulating layer 50a and substrate 50b. The insulating layer serves as a base upon which the conductive pattern is constructed. See column 5, lines 1-7. The insulating layer also provides suitable separation between the overlying semiconductor device and the substrate. Therefore it would have been obvious to one of

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ordinary skill in the art at the time of invention to include the insulating layer on the substrate of Liu for the reasons cited above.

13. Claim 114 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brennan et al. '943 in view of Cox '439 as applied to claims 2, 3, 9, 102 thru 110 thru 113 and 115 above, and further in view of Matsuno '502. Brennan in view of Cox does not disclose a fluorine-doped silicon oxide. However, Matsuno teaches that dielectric films doped with fluorine provide films with low dielectric constants. See, for example, see column 1, lines 20-63. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to add fluorine, in order to form a low dielectric film, and improve the overall speed of a semiconductor device.

#### *Response to Arguments*

14. Applicant's arguments with respect to claims 1-28, and 100-129 have been considered but are moot in view of the new ground(s) of rejection.

#### **INFORMATION ON HOW TO CONTACT THE USPTO**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 703-305-5695. The examiner can normally be reached on M-F 8-5.

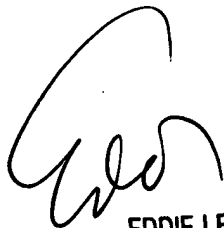
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 703-308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.



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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Eugene Lee  
February 24, 2002



EDDIE LEE  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800